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FLIGHT TEST REPORT OF THE MODEL OH-58A HELICOPTER WITH THE 206---ETC(U)
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206-194-122

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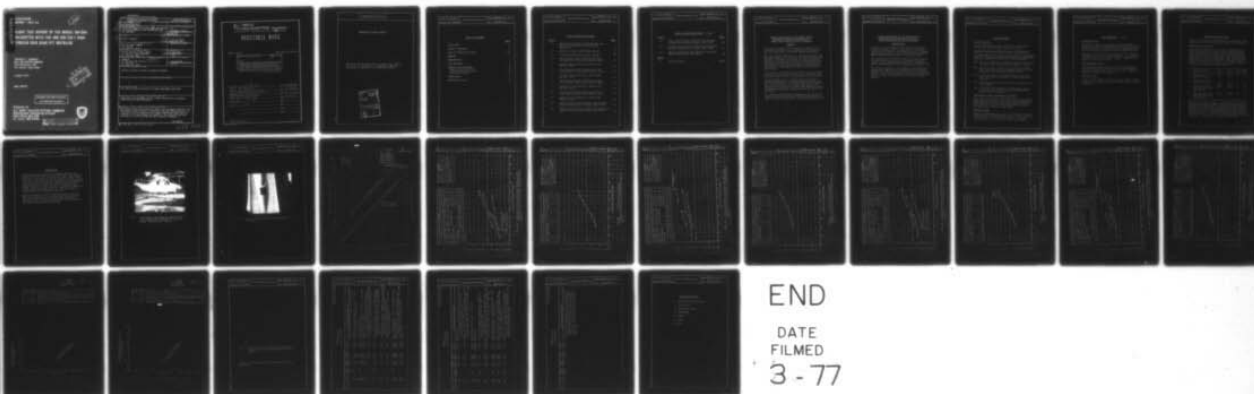
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USAAVSCOM
REPORT - TR77-12

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FLIGHT TEST REPORT OF THE MODEL OH-58A HELICOPTER WITH THE 206-706-129-1 HIGH TUBULAR SKID GEAR KIT INSTALLED

Thomas L. Sanders
BELL HELICOPTER COMPANY
Post Office Box 482
Fort Worth, Texas 76101

4 August 1972

FINAL REPORT

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Prepared for
U.S. ARMY AVIATION SYSTEMS COMMAND
Maintenance Engineering Division
Post Office Box 209
St. Louis, MO 63166



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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This report contains the results of a flight test evaluation conducted on the 206-706-129-1 high skid gear as installed on the model OH58A Helicopter. An L2700-206 HS ski kit, manufactured by Airglas Engineering Company was also installed on the high skid gear and evaluated. The limitations and hover performance of the basic OH-58A helicopter remained unchanged.		

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DATE 6-15-72

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HELICOPTER WITH THE 206-706-129-1
HIGH TUBULAR SKID GEAR KIT INSTALLED

PREPARED UNDER CONTRACT DAAJ01-70-C-0057
P.I.P. Task 69-2A

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DATE —

DATE —

DATE —

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MODEL OH-58A PAGE ii

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TABLE OF CONTENTS

	<u>Page</u>
TITLE PAGE	i
TABLE OF CONTENTS	ii
LIST OF FIGURES AND TABLE	iii
SUMMARY	v
INTRODUCTION	1
TEST EQUIPMENT	2
RESULTS AND DISCUSSION	4
Flight Characteristics	4
Vibration Characteristics	5
Hover Performance	6
CONCLUSIONS	7
DISTRIBUTION LIST	27

BY <u>T. L. Sanders</u>	BELL HELICOPTER COMPANY	MODEL <u>OH-58A</u>	PAGE <u>iii</u>
CHECKED <u>O.L. Norman</u>		RPT <u>206-194-122</u>	

LIST OF FIGURES AND TABLE

<u>Figure</u>		<u>Page</u>
1	Photo of High Tubular Skid Gear Kit and Snow Kit Installed on Model OH-58A Helicopter	8
2	Photo of Airglas L2700-206HS Ski Kit	9
3	Airspeed Calibration, Pilot's System	10
4	Static Longitudinal Stability and Controllability, 2991 lb GW, CG Sta. 106.0	11
5	Apparent Speed Stability, 2991 lb GW, CG Sta. 106.0	12
6	Static Longitudinal Stability and Controllability, 2252 lb GW, CG Sta. 114.2	13
7	Apparent Speed Stability, 2252 lb GW, CG Sta. 114.2	14
8	Static Longitudinal Stability and Controllability, 3006 lb GW, CG Sta. 106.0	15
9	Apparent Speed Stability, 3006 lb GW, CG Sta. 106.0	16
10	Static Longitudinal Stability and Controllability, 2342 lb GW, CG Sta. 114.2	17
11	Apparent Speed Stability, 2342 lb GW, CG Sta. 114.2	18
12	Pilot Seat Vertical Vibration Vs Indicated Airspeed During Level Flight, 2887 lb GW	19
13	Copilot Seat Vertical Vibration Vs Indicated Airspeed During Level Flight, 2887 lb GW	20

BY <u>T. L. Sanders</u>	BELL HELICOPTER COMPANY	MODEL <u>OH-58A</u> PAGE <u>iv</u>
CHECKED <u>O.L. Norman</u>		RPT <u>206-194-122</u>

LIST OF FIGURES AND TABLE - (cont)

<u>Figure</u>		<u>Page</u>
14	Pilot Seat Vertical Vibration Vs Indicated Airspeed During Level Flight, 2262 lb GW	21
15	Copilot Seat Vertical Vibration Vs Indicated Airspeed During Level Flight, 2262 lb GW	22
16	Photo of High Gear Skid Tube with Ten Pound Lead Weight and Ski Installed	23
<u>Table</u>		
I	Log of Flights	24-26

BY <u>T. L. Sanders</u>	BELL HELICOPTER COMPANY	MODEL <u>OH-58A</u> PAGE <u>V</u>
CHECKED <u>O.L. Norman</u>		RPT <u>206-194-122</u>

FLIGHT TEST REPORT OF THE MODEL OH-58A
HELICOPTER WITH THE 206-706-129-1
HIGH TUBULAR SKID GEAR KIT INSTALLED

SUMMARY

This report contains the results of a flight test evaluation conducted on the 206-706-129-1 high skid gear as installed on the Model OH-58A Helicopter.

The high tubular skid gear kit consists of basically the same tubular skid tubes as the standard gear, but attaches to higher cross tubes in order to provide additional ground clearance for the helicopter fuselage and tail rotor when landings in rough terrain are required. Two passenger steps are installed on the forward cross tubes for entry to and from the helicopter.

A ten pound lead weight was installed on the forward end of each skid tube to reduce gear vibration during flight and chatter during autorotation touchdown.

An L2700-206HS ski kit, manufactured by Airglas Engineering Company, was installed on the high skid gear for evaluation. A modified 206-050-221 (isolation spring) landing gear cross tube support was installed in addition to the aft 206-052-105-13 strap to reduce landing gear vibration when the ski kit is installed.

The limitations and hover performance that apply to the basic OH-58A Helicopter remain unchanged as the result of the high skid gear and ski kit installation.

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MODEL OH-58A PAGE 1

RPT. 206-194-122

FLIGHT TEST REPORT OF THE MODEL OH-58A
HELICOPTER WITH THE 206-706-129-1
HIGH TUBULAR SKID GEAR KIT INSTALLED

INTRODUCTION

A flight test evaluation of the Model OH-58A Helicopter, S/N 40621, with a high tubular skid gear and ski kit installed, was conducted from 11 January to 23 February 1972, at the Bell Helicopter Company (BHC) Flight Research Center, Arlington, Texas.

Test emphasis was directed toward the investigation of cabin vertical two-per-rev vibration and helicopter static longitudinal stability as influenced by the installation of the high skid gear and ski kit.

This report contains, in the Results and Discussion, information relative to the various configurations evaluated by BHC Flight Test Pilot Mr. L. W. Hartwig. However, data are not presented for all configurations evaluated, but are on file at the Flight Research Center.

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MODEL OH-58A PAGE 2

RPT 206-194-122

TEST EQUIPMENT

Test Helicopter

A Model OH-58A Helicopter, S/N 40621, was utilized as the test vehicle during the test program.

Landing Gear Kit, P/N 206-706-129-1 (See Figure 1)

The high tubular skid gear assembly provides increased ground to fuselage clearance as compared to the standard skid gear assembly and consists of the following:

- (a) Two cross tubes in the general shape of the standard gear cross tubes except extended in height.
- (b) Two skid tubes, similar to the standard tubular type skid tubes except extended in length at the toe and at the heel; P/N 206-052-108-5.
- (c) A step attached to the forward cross tube on each side of the helicopter to facilitate entry and exit.
- (d) An OH-58A 206-052-105 strap on the forward cross tube support.
- (e) A 206-052-105-3 strap was removed from the aft cross tube and replaced with a 206-052-105-13 strap, which is larger.

206-050-221 Cross Tube Support Assembly

This support assembly is utilized with the 206 popout float kit on the forward cross tube and isolates the skid tube from the fuselage. This support assembly was modified to accept a 206-052-105-13 strap and was installed on the aft cross tube.

OH-58A Ski Kit

Airglas Engineering Co., Inc., of Anchorage, Alaska, manufactured the L2700-206HS ski kit, which consisted of fiberglass skis with steel runners. A strap attaches the skis to the skid tube. See Figure 2.

BY <u>T. L. Sanders</u>	BELL HELICOPTER COMPANY POST OFFICE BOX 482 • FORT WORTH, TEXAS	MODEL <u>OH-58A</u> PAGE <u>3</u>
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TEST EQUIPMENT - (cont)

Instrumentation

An eighteen channel Consolidated Electrodynamics Corporation (CEC) oscillograph recorder was installed to record pilot and copilot vertical vibration data. The accelerometers utilized were the CEC Model A-69.

The fore and aft cyclic stick position was obtained through the use of a visual indicator. The indicator was driven by a rotary potentiometer, mechanically linked to the cyclic stick.

Airspeed Calibration

The airspeed system of the aircraft was calibrated by the trailing bomb method for the flight regimes of climb, level flight, and autorotation. Figure 3, page 10, presents the results.

Log of Flights

A log of all flights listing the data, flight number, duration time, purpose and/or configuration, is shown in Table I.

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RESULTS AND DISCUSSION

Prior to testing, all controls were checked for proper rigging and current weight and balance was obtained.

Flight Characteristics

Tests were conducted at the critical conditions of the center of gravity (cg) - gross weight (GW) envelope to determine the flight characteristics of the helicopter with the 206-706-129-1 high skid landing gear and snow ski kit installed. From previous test experience it has been determined that the two conditions of (1) heavy GW, forward cg, and (2) light GW, aft cg, are the most critical. As a result the following configurations were evaluated:

Configuration	GW	cg	Fig.	Page
1. 206-706-129-1 Kit, High Skid Gear	2991	106.0	4	11
2. 206-706-129-1 Kit, High Skid Gear	2252	114.2	6	13
3. 206-706-129-1 Kit, High Skid Gear and Snow Ski Kit	3006	106.0	8	15
4. 206-706-129-1 Kit, High Skid Gear and Snow Ski Kit	2342	114.2	10	17

Figures 4 through 7 present controllability, stability, and apparent speed stability data for the helicopter at forward cg (Fuselage Sta. 106.0), and aft cg (Fuselage Sta. 114.2) when the 206-706-129-1 high skid gear kit was installed. The passenger doors were on and landing gear steps installed. These flights represent the basic high skid gear configuration and the data show the flight characteristics to be satisfactory.

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CHECKED <u>O.L. Norman</u>		RPT <u>206-194-122</u>

RESULTS AND DISCUSSION - (cont)

Ground handling operations of the aircraft were satisfactory with the high skid landing gear kit installed.

The ski kit, L2700-206HS, was installed on the high skid gear and Figures 8 through 11 present controllability, stability, and apparent speed stability data for the helicopter at forward and aft cg flight conditions. Data indicate the flight characteristics are acceptable.

Vibration Characteristics

Tests were conducted at the critical condition of the cg-GW envelope to determine the vibration characteristics of the helicopter with the 206-706-129-1 high skid landing gear and snow ski kit installed.

Figures 12 through 15 present the pilot and copilot vertical vibration characteristics of the Model OH-58A Helicopter for the configurations shown.

During evaluation, the high skid gear exhibited unacceptable gear chatter during the slide-on portion of a touchdown autorotation. The addition of lead weights (ten pounds) to the forward end of the skid tubes (see Figure 16) damped the gear chatter and improved the in-flight vibration characteristics of the aircraft. Combinations of less skid tube weight and 206-050-221 (isolation springs) support assembly were evaluated, but were unacceptable due to gear chatter or fuselage vibration.

The L2700-206HS ski kit was installed on the high skid gear and flights made to determine fuselage vibration characteristics as the result of the installation. An excessive amount of skid shake existed above 80 knots. The two-per-rev vibration was considerably reduced with the installation of the ten pound lead weight on the forward end of each skid tube. However, the aft end of the skid tube continued

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MODEL OH-58A PAGE 6
RPT 206-194-122

RESULTS AND DISCUSSION - (cont)

to shake excessively. The aft oscillatory skid motion was damped by the installation of two 206-050-221 (isolation spring) aft cross tube support assemblies. This configuration resulted in an acceptable two-per-rev vertical vibration above 100 knots indicated air-speed (IAS). However, the support assembly was believed to be structurally inadequate and, as a result, the 206-050-221 support assemblies were modified by removing the 206-050-224-1 (strap) support and installing the large 206-052-105 strap (used with high skid gear). Also, the rubber bonded to the inside of the 206-052-105 strap was reduced .040 inch to allow more clearance between the cross tube and the cross tube support to improve isolation spring operation. This configuration produced a marginally acceptable two-per-rev vibration level through the speed regime. A more uniform rubber bond to the inside of the 206-052-105 strap would probably further reduce the two-per-rev vibration level.

All of the changes made to the test landing gear assembly have been incorporated in the production assemblies. The lead weights that were attached to the skid tubes, externally, have been replaced with weights located inside the forward end of the skid tubes.

Hover Performance

The test skid gear is approximately one foot higher than the standard skid gear and, as a result, the four-foot in-ground-effect (IGE) hover performance data previously published for the basic helicopter are the same as three-foot IGE hover performance for the test configuration.

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MODEL OH-58A PAGE 7

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RPT 206-194-122

CONCLUSIONS

A flight test evaluation of the Model OH-58A Helicopter, S/N 40621, with the 206-706-129-1 high tubular skid gear and ski kit installed has been successfully completed. On the basis of the results of these tests it is concluded that the new landing gear configurations did not have any significant effects on the flight characteristics of the helicopter. Therefore, the flight limitations that apply to the basic OH-58A Helicopter remain unchanged when the high skid gear is installed with or without the ski kit.

Hover performance with the high skid gear installed will be the same as for the basic helicopter except the skid height above the ground must be lowered from four feet to three feet in order to maintain the same rotor height above the ground.

BY <u>T. L. Sanders</u>	BELL HELICOPTER COMPANY	MODEL <u>OH-58A</u> PAGE <u>8</u>
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Fig. 1 High Tubular Skid Gear Kit and Snow Kit
as Installed on the Model OH-58A Heli-
copter, BHC Photo No. 385277

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MODEL OH-58A PAGE 9

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RPT. 206-194-122

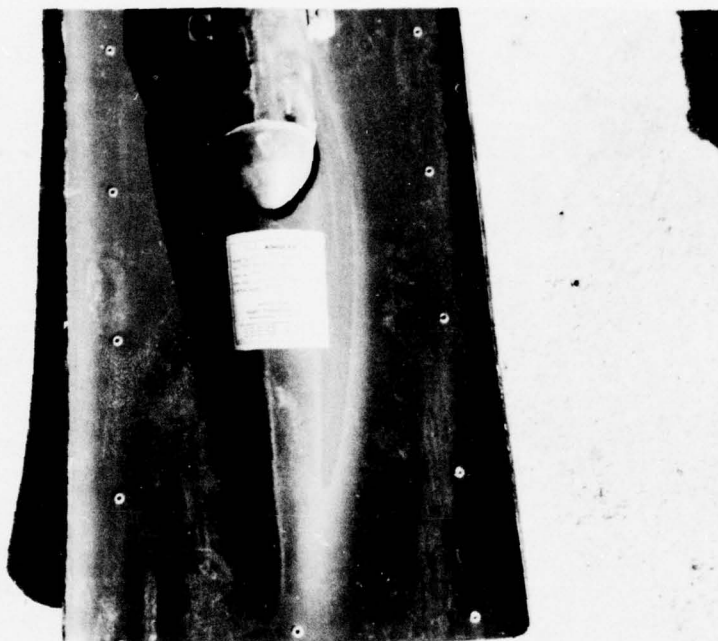


Fig. 2 Airglas L2700-206HS Ski Kit, BHC Photo
No. 385275

MODEL OH 58A
40621
FLT. 5A
DATE 12 JAN 71
ESGW 2412
ESCG 109.05
CONFIG. HIGH
SKID GEAR
LINE OF ZERO ERROR

LEGEND

- CRUISE
- CLIMB
- △ AUTO

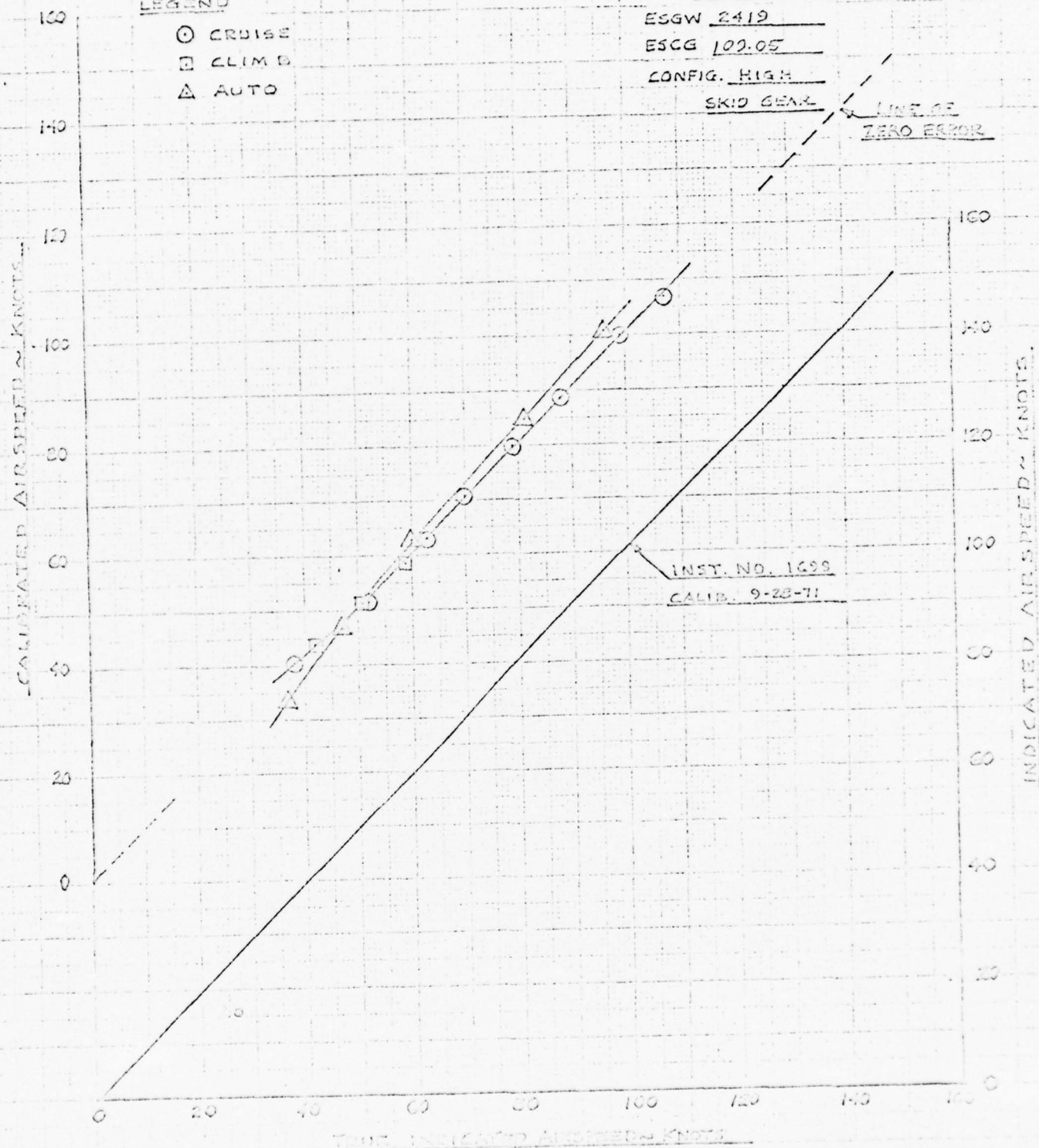


FIG 3 AIRSPEED CALIBRATION - PILOTS SYSTEM

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MODEL OH-58A
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PAGE 11
RPT 206-194-122

MILITARY S/N 70-15070

BELL S/N 40621

FLIGHT NO 7B

DATE 1-14-72

CONFIGURATION 206-706-129-1

HIGH TUBULAR SKID GEAR

KIT INSTALLED

LEGEND

SYM	FLIGHT CONDITION	AIR SPEED TRIM	KCAL RANGE	ROTOR RPM	H ₇ ~ FT	OAT ~ °C
○	LEVEL FLIGHT	39 KTS.	15-60 KTS.	354	2000	0
□	LEVEL FLIGHT	1.8 V _{MAX}	1.6 V _{MAX} - V _{MAX}	354	2000	0
△	LEVEL FLIGHT	1.0 V _{MAX}	1.8 V _{MAX} - V _L	354	2000	0
◇	CLIMB	V _{MAX} R/C = 15 KTS.		354	2000	0
○	AUTOROTATION			354	2000	0
◇	HOVER			354	100	2
○	REARWARD					

NOTE: SOLID SYMBOLES ARE THE TRIM CONDITIONS

3540 CONTROLLABILITY

100 - FULL FWD

LONGITUDINAL CYCLIC CONTROL POSITION ~ % FROM FULL AFT

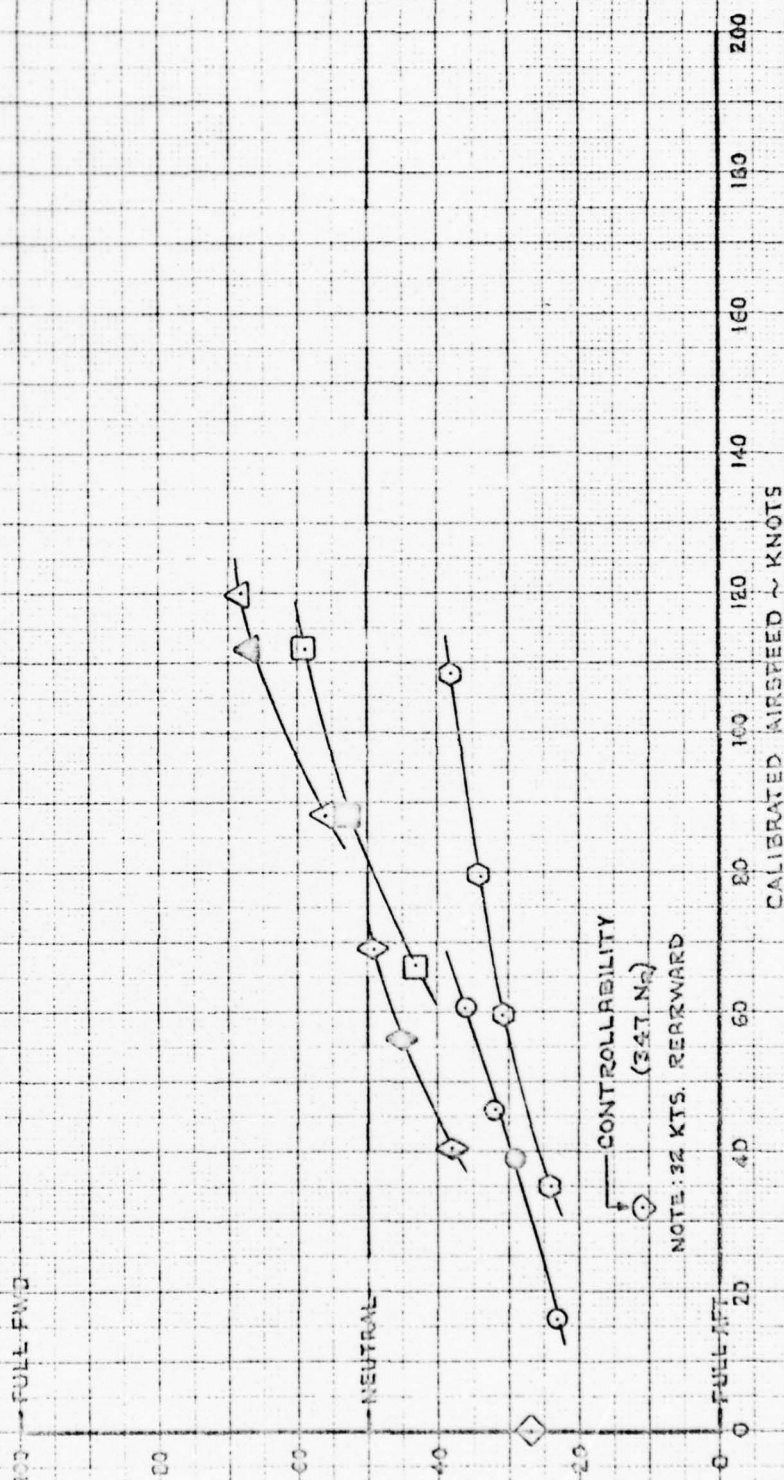


FIG. 4 STATIC LONGITUDINAL STABILITY & CONTROLLABILITY
2991 LB.G.W. LONG.C.C. STA. 106.0 IN. DENSITY ALT. 650 FT.

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PAGE 12
RPT 206-194-122

MILITARY S/N 70-15070
BELL S/N 40621
FLIGHT NR. 78
DATE 1-14-72
CONFIGURATION 206-706-129-1
HIGH TUBULAR SKID GEAR
KIT INSTALLED

LEGEND				
SYM	FLIGHT CONDITION	A/S RANGE KCAS	ROTOR RPM	HR DAT FEET °C
○	LEVEL FLIGHT		354	2000 0

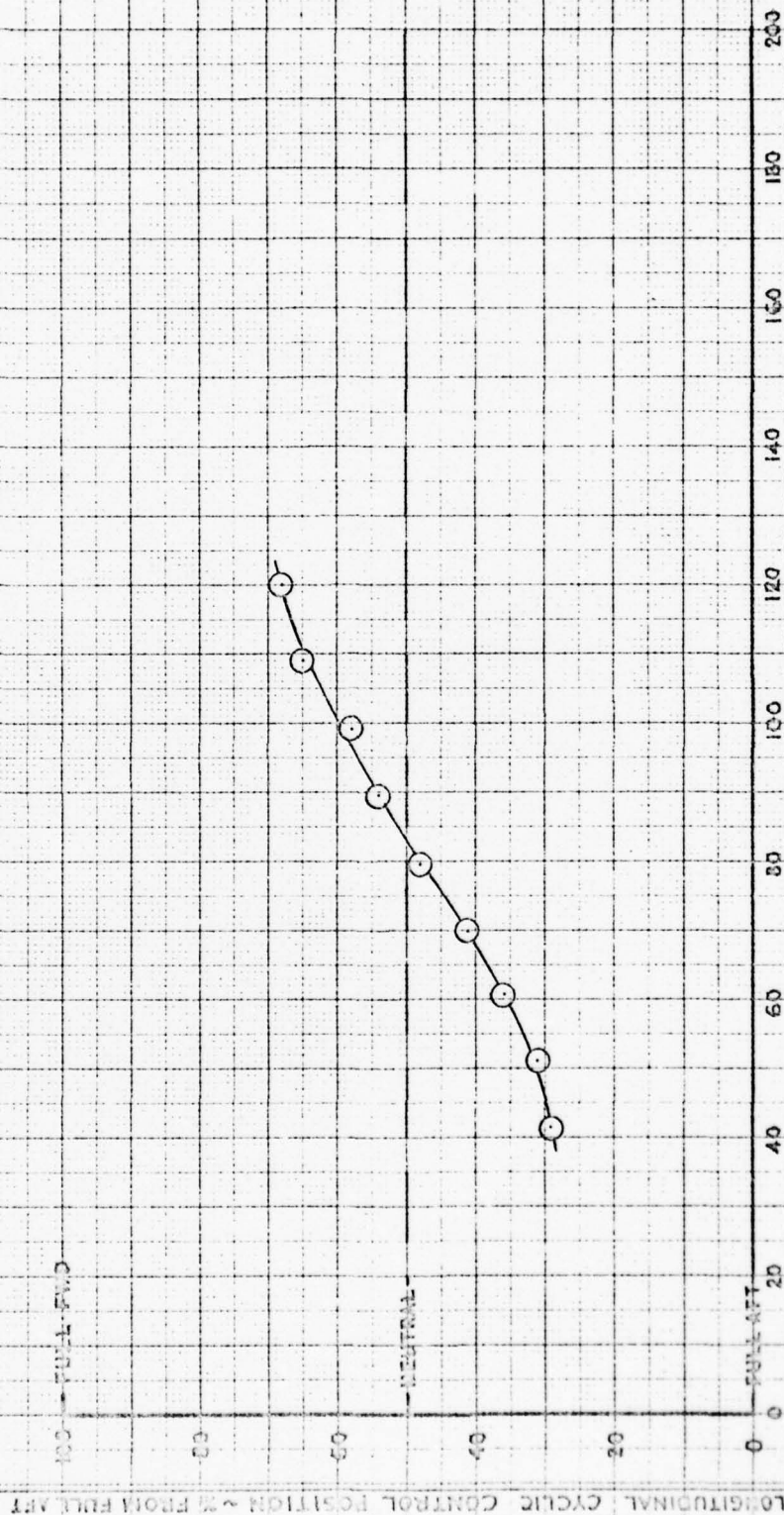


FIG. 5 APPARENT SPEED STABILITY
2991 LB.G.W. LONG. C.G. STA. 106.0 DENSITY ALT. 660 FT.

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FORT WORTH, TEXAS

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PAGE 13
RPT 206-194122

MILITARY S/N TO-16070
ELL S/N 40621
FLIGHT NO 7A
DATE 1-14-72
CONFIGURATION: 206-706-129-1
HIGH TUBULAR SKID GEAR
KIT INSTALLED

LEGEND				
SYM	FLIGHT CONDITION	AIR SPEED KNOTS TRIM RANGE	ROTOR RPM	HP ~ FT
○	LEVEL FLIGHT	39 KTS	354	2000
□	LEVEL FLIGHT	3 VMAX	354	2000
△	LEVEL FLIGHT	1.0 VMAX	354	2000
◇	CLIMB	1.0 VMAX	354	2000
◇	AUTOROTATION	VMAX R/C	354	2000
◇	HOVER	±15 KTS	354	2000

NOTE: SOLID SYMBOLS ARE THE TRIM CONDITIONS

100% FULL FWD

CONTROLABILITY
(347 Hz)

LONGITUDINAL CYCLIC CONTROL POSITION ~ % FROM FULL AFT

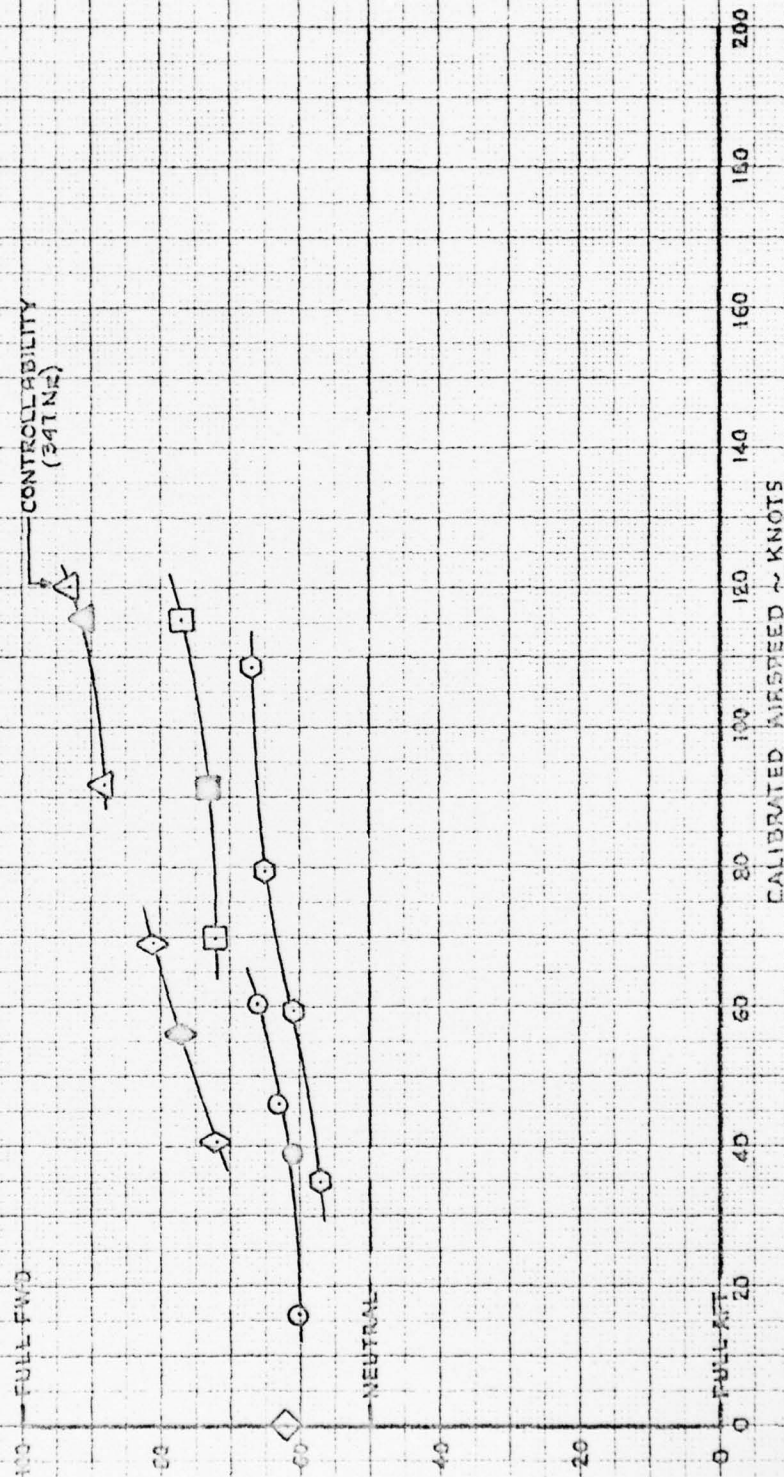


FIG. 6 STATIC LONGITUDINAL STABILITY & CONTROLABILITY
2252 LB.G.W. LONG.C.G. STA. 114.2 IN. DENSITY ALT. 905 FT.

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FORT WORTH, TEXAS

MODEL OH-58A
DEL

PAGE 14
RPT 206-194-122

MILITARY S/N 70-15070
DEL S/N 40621
FLIGHT NO. 7A
DATE 1-14-72
CONFIGURATION 206-706-129-1
HIGH TUBULAR SKID GEAR
KIT INSTALLED

LEGEND			
SYM	FLIGHT CONDITION	CCAS	HR
○	LEVEL FLIGHT	354	2000
			2



FIG. 7 APPARENT SPEED STABILITY
2252 LB. GW. LONG. C.G. STA. 114.2 DENSITY ALT. 905 FT.

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1001 OFFICE, 204 481 1001 WORTH L. 25841

MODEL OH-58A
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PAGE 15
RPT 206-194-122

MILITARY S/N 70-15070

BELL S/N 40621

FLIGHT NO 12A

DATE 2-16-72

CONFIGURATION: 206-706-129-1

HIGH TUBULAR SKID GEAR KIT

AND L2700-206HS SKI KIT

INSTALLED

LEGEND				
SYM	FLIGHT CONDITION	AIR SPEED KNOTS TRIM RANGE	ROTOR RPM	ALTITUDE FT
○	LEVEL FLIGHT	39 KT. 15-60 KT.	354	2000
□	LEVEL FLIGHT	39 MAX 60 MAX - V _{MAX}	354	2000
△	LEVEL FLIGHT	110 MAX 150 MAX - V _L	354	2000
◇	CLIMB	V _{MAX} RQ ±15 KT.	354	2000
○	AUTOROTATION		354	2000
◇	HOVER		354	2000
○	REARWARD		354	2000

NOTE: SOLID SYMBOLS ARE THE TRIM CONDITIONS

LONG. CONTROLABILITY

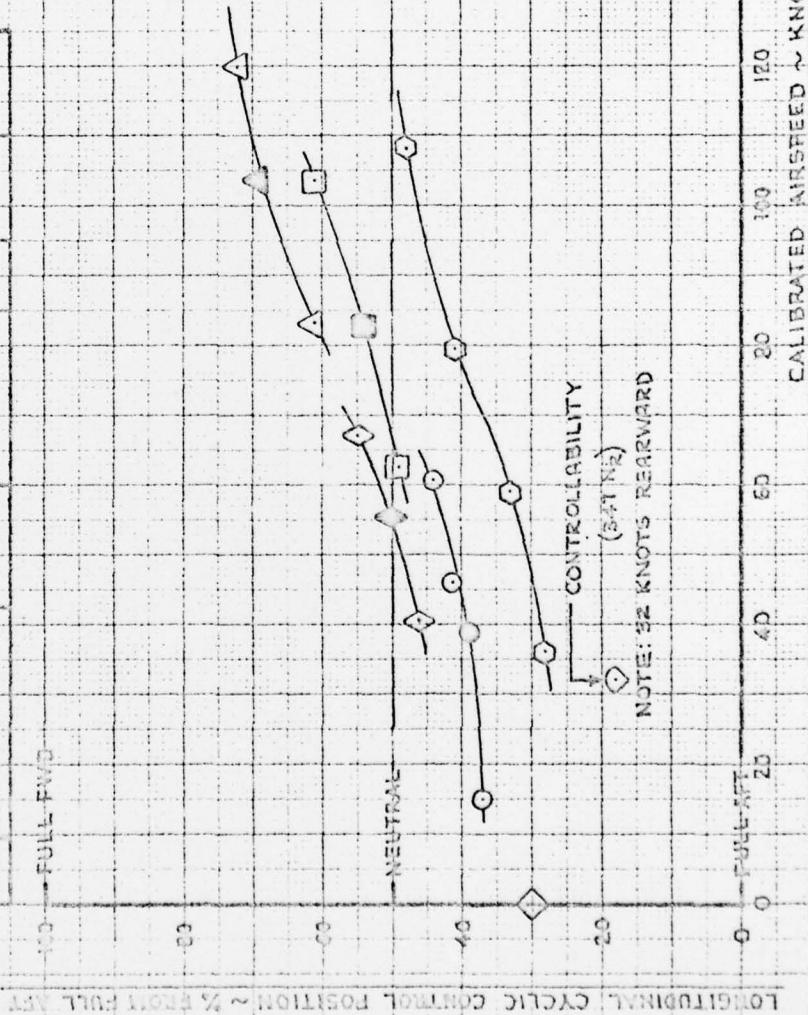


FIG. 8 STATIC LONGITUDINAL STABILITY & CONTROLLABILITY
3006 LB. GV. LONG. CG STA. 10% IN. DENSITY ALT. 1760 FT.

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MODEL OH-58A
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PAGE 16

RPT 206-194-122

MILITARY S/N	70-15070
SEIL S/N	40621
FLIGHT NO.	12A
DATE	
CONFIGURATION	206-706-129-1
HIGH TUBULAR SKID GEAR	
KIT AND L2100-206H5 SKI KIT	
INSTALLED	

LEGEND			
SYM	FLIGHT CONDITION	A/S RANGE KCAS	ROTOR RPM FEET °C
①	LEVEL FLIGHT	354	2000 8

SOLID SYMBOL DENOTES CONTROLLABILITY POINTS

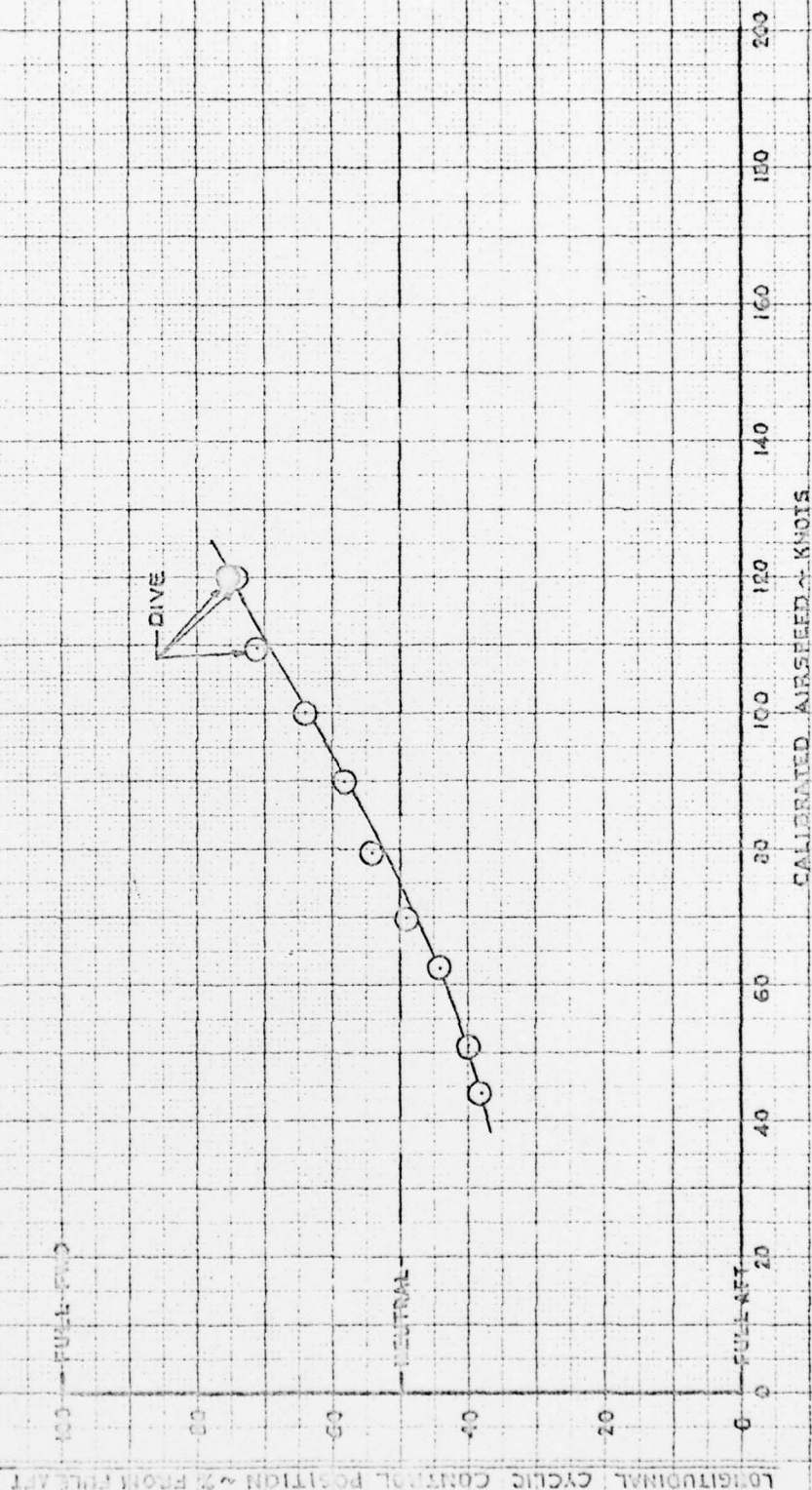


FIG. 9 APPARENT SPEED STABILITY
3006 LB. GW. LONG. C.G. STA 106.0 DENSITY ALT. 1640 FT.

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PAGE 17

RPT 206-194-122

MILITARY S/N 70-15070
BELL S/N 40621
FLIGHT NO 11R
DATE 2-15-72
CONFIGURATION: 206-T06-129-1
HIGH TUBULAR SKID GEAR KIT
AND L2700-206HS 15KI
KIT INSTALLED

LEGEND				
SYM	FLIGHT CONDITION	AIR SPEED (KAL TRIP)	ALTITUDE (FT)	TEMP (°C)
○	LEVEL FLIGHT	39 KT. 15-60 KT.	354 1250	5
□	LEVEL FLIGHT	0 V _{MAX} 6 V _{MAX} - V _{MAX}	354 1500	5
△	LEVEL FLIGHT	1.0 V _{MAX} 3 V _{MAX} - V _L	354 1500	5
◇	CLIMB	V _{MAX} R/C ±15 KT.	354 1500	5
○	AUTOROTATION		354 3000	2
◇	HOVER		354 550	8

NOTE: SOLID SYMBOLS ARE THE TRIM CONDITIONS

LONGITUDINAL STABILITY

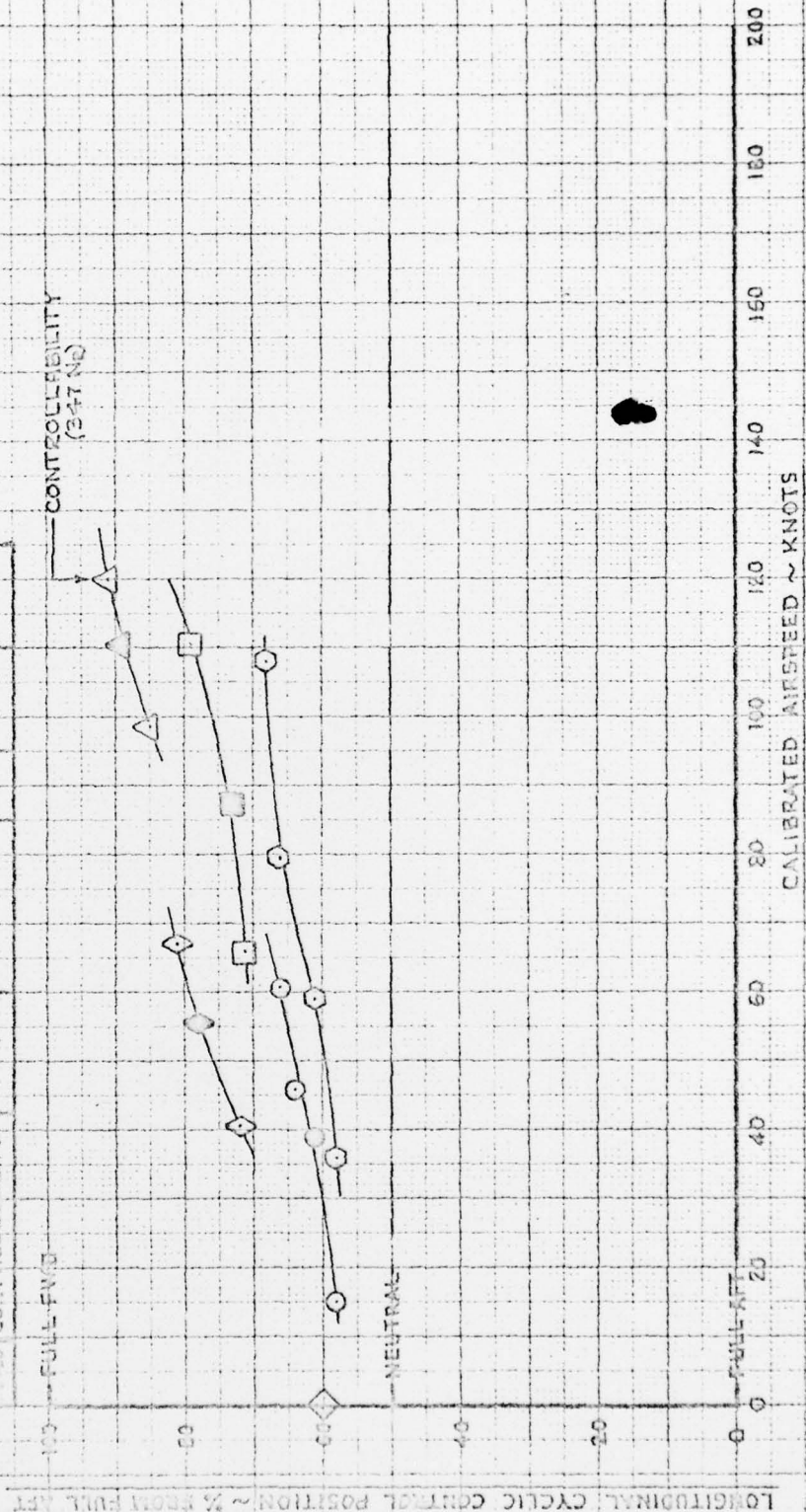


FIG. 10 STATIC LONGITUDINAL STABILITY & CONTROLLABILITY
2342 LB. GW. LONG CG. STATION 42 IN. DENSITY ALT. 660 FT.

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MODEL OH-58A
HEL

PAGE 18
RPT 286-194-122

MILITARY S/N 70-15070
BEA S/N 40621
FLIGHT NO. 11B
DATE 12-15-72
CONFIGURATION: 206-706-129-1
HIGH TUBULAR SKID GEAR
KIT AND L2700-200HS SKI KIT
INSTALLED

LEGEND			
SYM	FLIGHT CONDITION	A/S RANGE (GAS)	ROTOR RPM
○	LEVEL FLIGHT	554	1500
			12

SOLID SYMBOL DENOTES CONTROLLABILITY POINT - 347NR

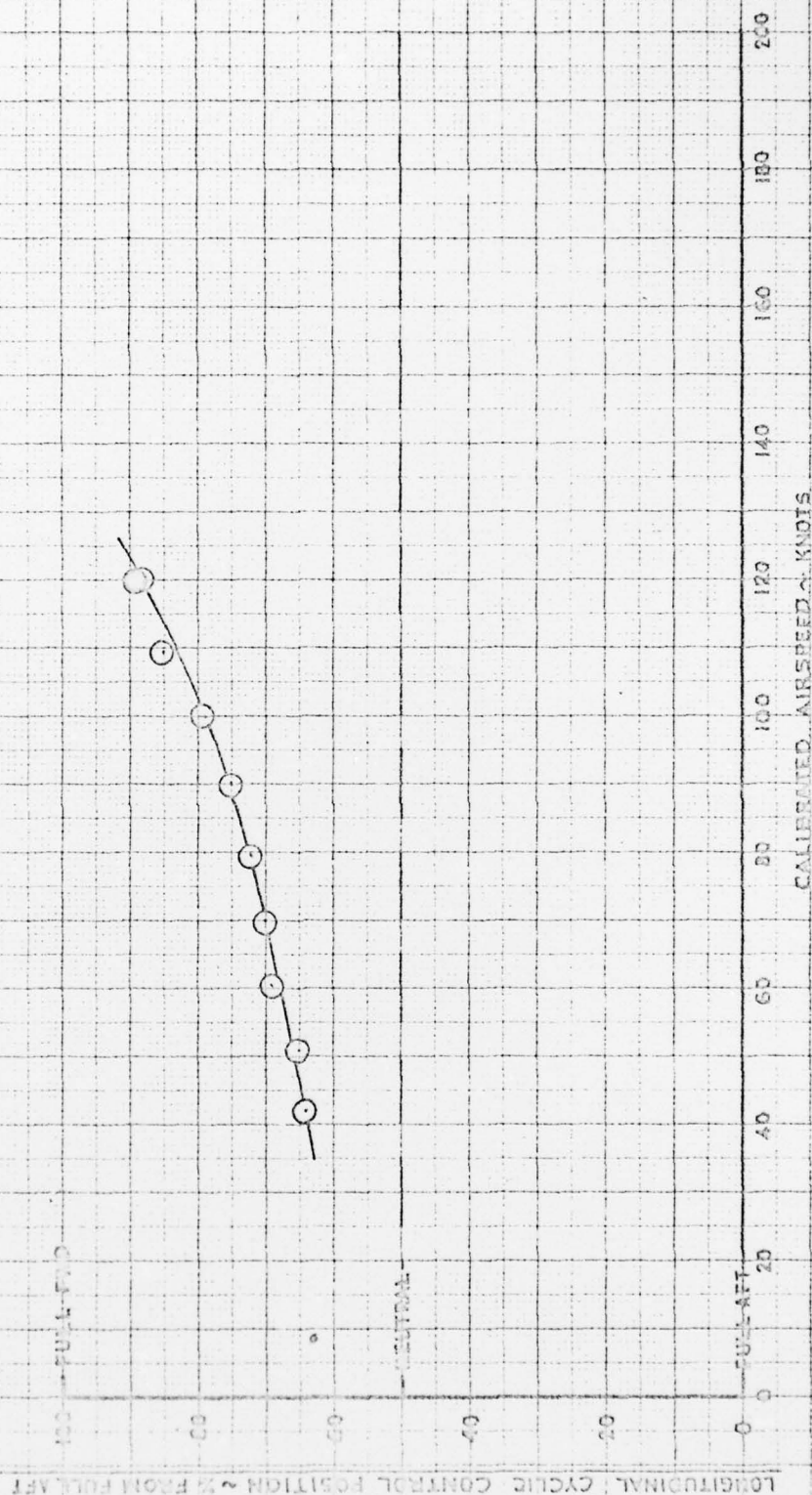


FIG. 11 APPARENT SPEED STABILITY
2342 LB. GW. LONG. C.G. STA. 14.2 DENSITY ALT. 1500 FT.

MODEL OH-58A PART 19
 70-15070 206-194-122
 BELL NO. 40621

SYM	FLT. NO.	DATE	CONFIG.
---	4A	1-11-72	206-706-129-1 HIGH SKID GEAR
---	7B	1-14-72	206-706-129-1 HIGH SKID GEAR W/206-050-Z21-3 X-TUBE SUPP. ASSY.
.....	7D	1-14-72	206-706-129-1 HIGH SKID GEAR W/10 LB. LEAD WT. EACH SKID TUBE
---	9C	1-17-72	STANDARD OH-58A SKID GEAR
---	14	2-23-72	206-706-129-1 HIGH SKID GEAR AND LZ100-206HS SKI KIT

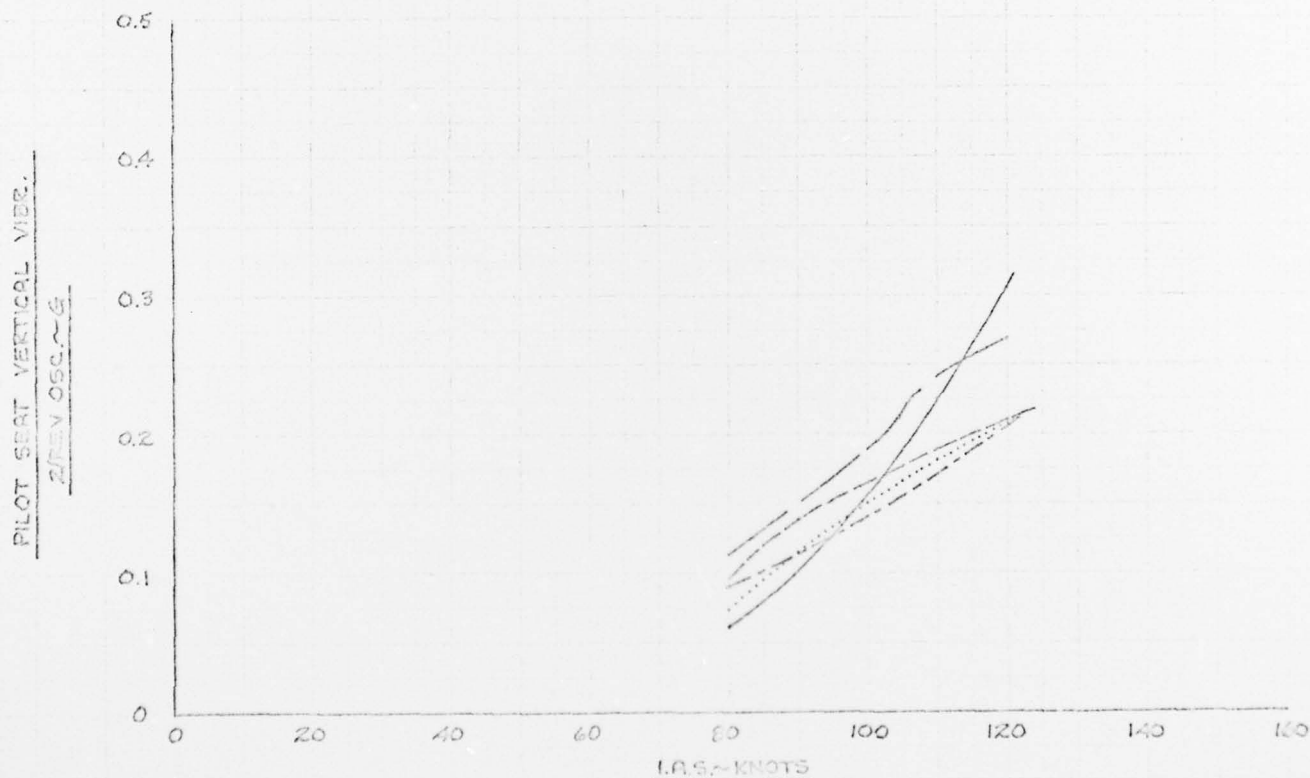


FIG. 13. PILOT SEAT VERTICAL VIBRATION VS. INDICATED AIRSPEED
 DURING LEVEL FLIGHT

845, G.W. 2597 LB.

C.G. STA. 107.0 IN.
 (FLT. 4A STA. 107.0 IN.)

BY _____
 APPROVED _____

BELL HELICOPTER COMPANY
 2001 HELICOPTER AVE. HOUSTON, TEXAS 77060

MODEL OH-58A PAGE 20
 NELL 70-15070 DTI 206-194-122
 BELL NO. 40621

SYM	FLT. NO.	DATE	CONFIG.
---	4A	1-11-72	206-706-129-1 HIGH SKID GEAR
---	7B	1-14-72	206-706-129-1 HIGH SKID GEAR W/206-050-221-3 X-TUBE SUPP. ASSY.
---	7D	1-14-72	206-706-129-1 HIGH SKID GEAR W/10 LB. LEAD WT. EACH SKID TUBE
---	9C	1-17-72	STANDARD OH-58A SKID GEAR
---	14	2-23-72	206-706-129-1 HIGH SKID GEAR AND L2700-206H3 SKI KIT

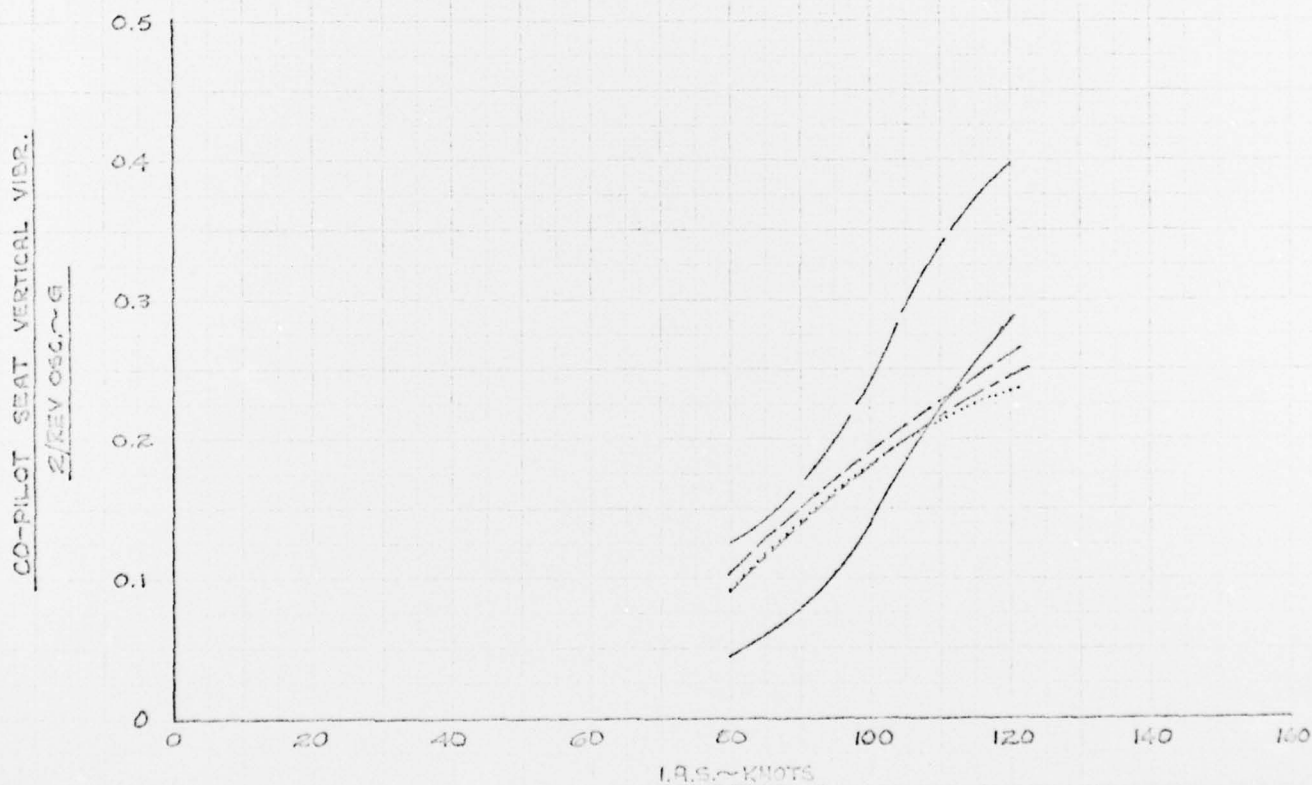


FIG. 13 Co-PILOT SEAT VERTICAL VIBRATION Vs. INDICATED AIRSPEED
 DURING LEVEL FLIGHT
 AVG. GVX2757 LB. C.G. STA 105.0 IN.
 (FLT. IN STR. POSITION)

BY

EVALUATED

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MODEL OH-58A

PAGE 21

SERIAL 70-15070

SPT 206-174-122

BELL NO. 40621

SYM	FLT. NO.	DATE	CONFIG.
---	4B	1-11-72	206-706-129-1 HIGH SKID GEAR
---	7A	1-14-72	206-706-129-1 HIGH SKID GEAR W/206-050-221-3 X-TUBE SUPP. ASSY.
---	7E	1-14-72	206-706-129-1 HIGH SKID GEAR W/10 LB. LEAD WT. EACH SKID TUBE
---	9B	1-17-72	STANDARD OH-58A SKID GEAR
---	11B	2-15-72	206-706-129-1 HIGH SKID GEAR AND L2700-206 HS SKI KIT

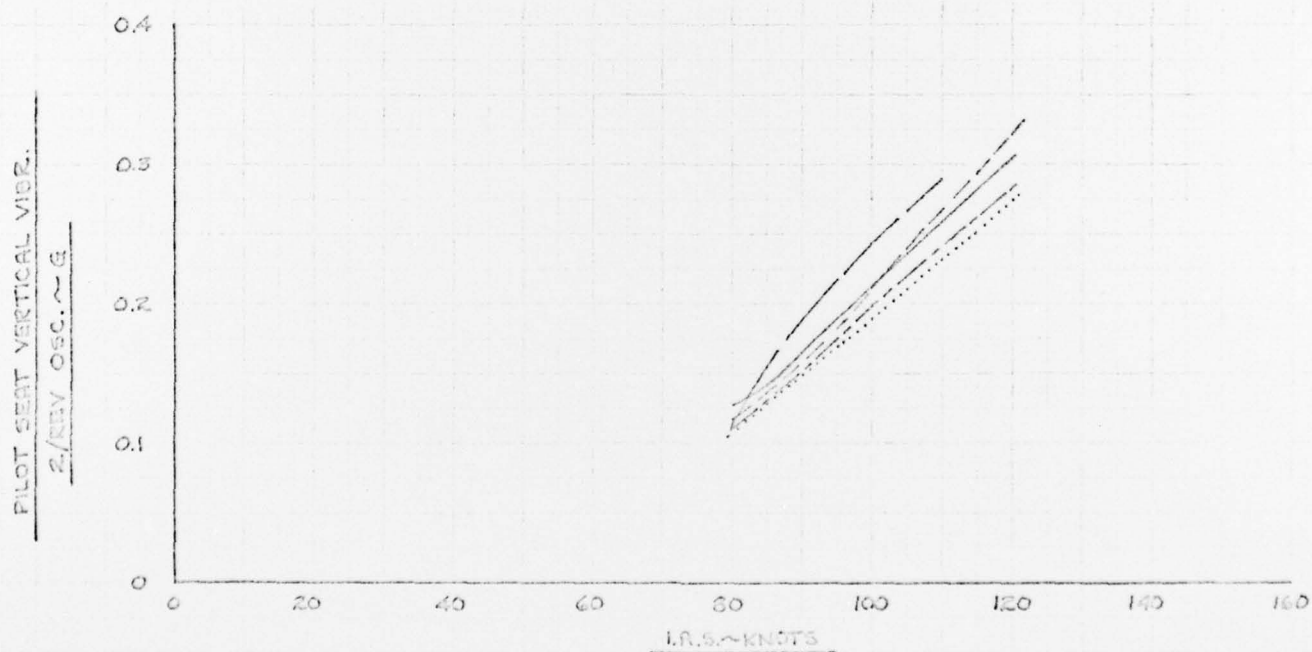


Fig. 14 PILOT SEAT VERTICAL VIBRATION VS. INDICATED AIRSPEED
DURING LEVEL FLIGHT

AVG. GND. 225 LBS.

C.G. 77.114 IN.

57

CHARTED

BELL LANDING GEAR COMPANY

MODEL OH-58A

PAGE 22

70-15070

206-194-122

BELL NO. 40621

SYM	FLT. NO.	DATE	CONFIG.
---	4B	1-11-72	206-706-129-1 HIGH SKID GEAR
---	7A	1-14-72	206-706-129-1 HIGH SKID GEAR W/206-050-221-3 X-TUBE SUPP. ASSY.
.....	7E	1-14-72	206-706-129-1 HIGH SKID GEAR W/10 LB. LEAD WT. EACH SKID TUBE
---	9B	1-17-72	STANDARD OH-58A SKID GEAR
---	11B	2-15-72	206-706-129-1 HIGH SKID GEAR AND LZ700-206HS SKI KIT

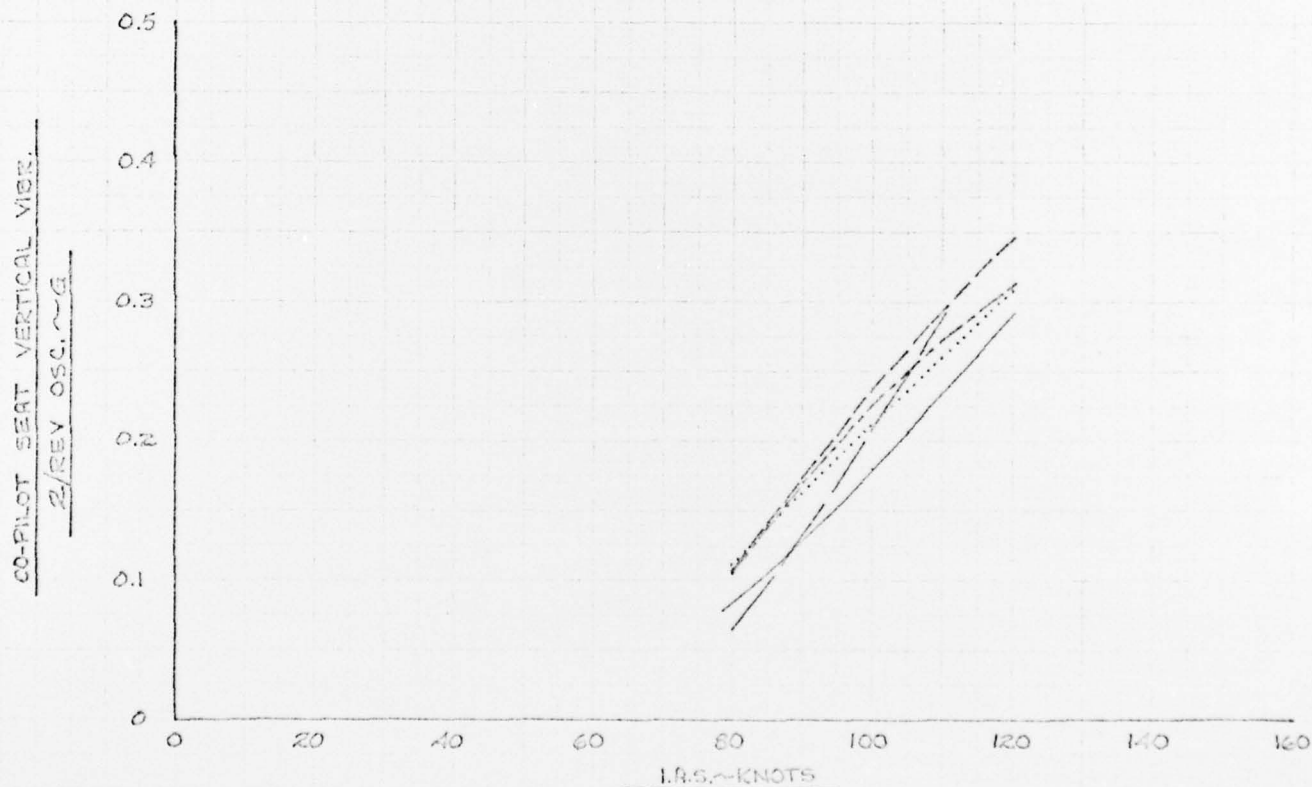


FIG. 15 Co-Pilot Seat Vertical Vibration Vs. Indicated Airspeed
During Level Flight

AVE. G.W. 2550 LB.

C.G. STR. 114.2 IN.

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MODEL OH-58A PAGE 23

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RPT 206-194-122



Fig. 16 High Gear Skid Tube With Ten Pound Lead Weight* and Ski Installed, BHC Photo No. 385276

*Production skid tubes have lead weights located internally.

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POST OFFICE BOX 482 • FORT WORTH, TEXASMODEL OH-58A PAGE 26RPT. 206-194-122Sheet 3 of 3TABLE I

LOG OF FLIGHTS

G. R. No.	Flt No.	1972 Date	Time (hr)	G. W. (lb)	G. G. Sta.	Configuration/Purpose
	14	2-23	0.3	3006	106.0	Snow ski kit installed, 10 lb lead weight on each skid tube, 206-050-221 cross tube support assy modified to accept 206-052-105-13 strap which had .040 in. rubber removed to allow more clearance between cross tube and improve spring assembly operation

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